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MONOPLANES OR BIPLANES?

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MONOPLANES OR BIPLANES?

By Edward P. Warner.

The discussion of the relative merits of the several possible wing arrangements in an airplane, of the advantages to be derived by using a single set of wings in a single plane or two or three superposed sets, has lasted even longer than the argument between the partisans of thin and thick wing sections, and the two questions seem equally far from a definite and all-inclusive solution. There has never been a time, since 1908, when monoplanes and biplanes were not in direct competition and giving results nearly enough the same so that both types had to be reckoned with, and that the choice between them was difficult in planning an airplane for any new purpose.

In 1909 and 1910 it appeared that the field could be divided between the two types so definitely that there would be little overlapping. The monoplane was to be the airplane for racing and for general use where high speed was required, while the biplane would receive preference for long flights and for use by comparatively unskilled pilots. Strange to say, one at least of those predictions has found itself directly reversed by experience, for the most unqualified statement that can be made on the subject at the present time is that the biplane is showing itself distinctly

* From the Christian Science Monitor.

superior to the monoplane for racing purposes, the difference in maximum speed between the fastest examples of the two types being close to 20 miles an hour. The monoplane, on the other hand, is now being used for training and for commercial transport, although it has neither of those fields to itself.

Summary of the Choice.

In brief summary, the most important advantages of the biplane are the possibility of using external bracing more effectively, somewhat lower wing weight, the possibility of using higher aspect ratio, or ratio of span to chord of wings, greater compactness, and the offering of a better and less obstructed field of view in some directions and under some conditions. The monoplane offers as its chief arguments the avoidance of loss of wing efficiency by interference between the several wings, easier assembly and maintenance, and a better view in most directions.

The factors which enter into airplane design can be arranged under the three general headings of aerodynamic efficiency, structural strength and general layout for easy construction and maintenance and for the comfort and convenience of pilot and passengers. In making comparison between the monoplane and biplane under those three headings successively, it should be understood that the difference between typical airplanes of the two types and of recent design goes deeper than the use of a different number of wings. The monoplane is characteristically an internally braced type, using a wing

section of great thickness, and the external bracing through wires which used to be employed on all monoplanes now appears with few exceptions, only on biplane and triplane combinations. The discussion of monoplane and biplane must, therefore, have much in common with the analysis of the rivalry between thick and thin wings which has already appeared in this column.

Aerodynamic Qualities.

In respect of aerodynamic qualities, there is little to choose between the single set of wings and the superposed sets. The more efficient structural arrangement of the biplane makes it possible, as already noted, to use high aspect ratios and thin wing sections, both of which would be favorable to high performance if everything else were exactly equal, but the advantage thus gained is counterbalanced by the elimination of interference between the wings and by the suppression of struts and wires, all of which add to the total resistance encountered in the monoplane. Insofar as there is any difference, it is in favor of the thin wing, and so of the biplane, at very high speeds, and of the thick wing, most often used in monoplanes, at more moderate velocities, such as are used in commercial operation.

Stability and control, like the factors directly affecting performance, come under the head of aerodynamics, and again there is little difference between the two types. There used to be a common belief, backed by no very concrete evidence except that of experience

with one or two particular designs, that the monoplane was hard to fly, tricky, and unsafe. For about a year prior to the beginning of the war, in fact, the use of all monoplanes owned by the British Air Service had been discontinued and the airplanes placed in dead storage. This prejudice had no sound basis for general application, however, for a properly-designed monoplane is perfectly normal in its behavior and quite as easy to fly as another sort of airplane. The French Army even uses monoplanes for primary training, with perfectly satisfactory results.

Structurally, the advantage rests entirely with the biplane. The use of two wings, set parallel to each other and at a considerable distance apart, makes for an almost ideal simplicity of bracing where wires external to the wings are to be used. A biplane structure can accordingly be made considerably lighter for a given strength than can the monoplane, in which the members supporting the wing must be entirely self-contained or brought directly from the body, with no intermediate bracing points.

Something for Both Sides.

In comparing the general layout of the two types, there is something to be said on both sides. The biplane starts with a great advantage in being more compact, having smaller over-all dimensions for a given area and therefore requiring less hangar space for storage. The monoplane, however, is much easier to assemble and requires no alignment, for a thick wing is built as a unit and cannot get out of shape unless it is actually damaged structurally. Since

the wing is all in one piece and is held in place only by a few bolts, it takes fewer minutes to remove or replace it as a whole than it does hours to perform the same operation on the wings of a biplane.

The most important difference of all for certain sorts of service is that in field of view. In most cases the monoplane wing is placed above the body, approximately on a level with the pilot's eye. The view vertically downward is therefore entirely unobstructed, while in the biplane the lower wing is always in the way. This is of decided importance in commercial airplanes, where a clear view of the ground is a great attraction to passengers, and in airplanes for military and naval observation, where the whole purpose of the design is defeated if the observer cannot see what is happening below him. The thick wing somewhat interferes with the pilot's vision to the front, to be sure, but this handicap can be overcome by placing the pilot forward of the wing, beside the engine, as in the Fokker commercial monoplanes, or by reducing the thickness locally over the body.

Balancing all of these qualities against each other, the biplane seems likely to continue in favor for racing, for high-speed pursuit airplanes, for seaplanes, and probably for bombing airplanes of very large size, with the triplane as a possible rival for the last purpose. It is probable, however, that the monoplane will gradually come to have the fields of commercial passenger transport, of sport and touring, and of military observation more and more to itself.